

## PERSONAL PRACTICE

## The range of visceral manifestations of non-accidental injury

C S Ng, C M Hall, D G Shaw

Non-accidental injury (NAI) in children under the age of 17 years has an estimated incidence in the USA of 2.5%, and is considered to be on the increase.<sup>1</sup> The range of skeletal, intracranial, and orbital manifestations in NAI have been well described.<sup>2-8</sup> In comparison, visceral manifestations (excluding the superficial and cutaneous injuries) are much less common and less well recognised; they are considered to contribute less than 2% of injuries in NAI.<sup>9</sup>

Abdominal injuries in NAI arise mainly from blunt trauma, and include contusion, laceration, and rupture of solid or hollow viscera, for example of the liver, spleen, pancreas, kidneys, and bowel. Duodenal haematomas and mesenteric tears may also occur. Vascular injuries are less common and include avulsion of the superior mesenteric artery and pseudoaneurysms of the abdominal aorta.<sup>10</sup> Chylous ascites after abdominal trauma has been described.<sup>11</sup>

Blunt thoracic injuries commonly result in rib fractures in the infant, but intrathoracic visceral injuries are much less common than abdominal visceral injuries.<sup>12</sup> The former include lung contusions, chylothoraces, and cardiac lacerations and rupture.<sup>11 13</sup>

Superficial and cutaneous injuries, for example, bruises, cuts, burns, injuries to the pinna, frenulum of the mouth, and genitalia can impart information on the mechanisms of injury. They are well described and are not discussed in detail in this paper.

Patients with visceral manifestations of NAI have been selected from a group of 300 patients referred or admitted for alleged physical abuse. The cases include pharyngeal, abdominal, and pelvic trauma. The radiological findings are illustrated and correlated in all cases bar one, with surgical or postmortem findings.

### Case reports

#### PATIENT 1: PHARYNGEAL TRAUMA AND PHARYNGEAL FOREIGN BODY

A 7 week old infant was brought by her father to a casualty department with respiratory distress. Stridor, drooling, and mild desaturation were noted. She had blood in the oropharynx, and a soft tissue swelling in the right soft tissues of the neck.

Radiographs of the neck and chest showed a retropharyngeal soft tissue swelling containing air, which was associated with loss of the normal cervical lordosis and deviation of the

trachea to the left. Ultrasound of the neck showed a large amount of highly echogenic material, consistent with air, in the right parapharyngeal space between the trachea and the carotid sheath, with displacement of the carotid sheath laterally. A contrast swallow showed a retropharyngeal swelling with air in the soft tissues, a leak in the posterior pharynx (see fig 1).

Examination under general anaesthesia revealed a massive full thickness laceration of the wall of the right side of the hypopharyngeal wall, extending from the inferior pole of the right tonsil down to the apex of the right pyriform fossa, just above the cricopharyngeus. The laceration and neck space, which it led into, was filled with cotton wool-like material wedged into a large cavity in the neck which lay immediately posterior to the carotid sheath. There was also a torn frenulum.

The child was placed on the child protection register on the grounds of actual physical abuse.

#### PATIENT 2: PHARYNGEAL TRAUMA WITH MEDIASTINAL EMPHYSEMA

A 4 month old child presented with a history of two haemoptyses in the preceding two weeks and a six week history of a cough with noisy breathing. On admission he was not swallowing his secretions and was febrile.

A chest radiograph showed mediastinal air and subcutaneous emphysema in the neck and axilla (see fig 2A). Computed tomography showed gas within the soft tissues of the pharyngeal wall (see fig 2B) and in the mediastinum. Examination under general anaesthesia revealed an ulcer in the oropharynx in the right pyriform fossa. A biopsy confirmed the presence of an ulcer, but with no specific features. The conclusion was of a traumatic pharyngeal trauma, but the precise mechanism was not elucidated.

Ten weeks later, the infant was admitted to a different hospital with a parietal skull fracture, a spiral fracture of the humerus, and fractures of the ulna and of the surgical neck of the humerus.

#### PATIENT 3: RUPTURE OF THE DUODENUM AND SPLENIC TRAUMA

A 7 month old girl was brought to a casualty department with a seven day history of diarrhoea and vomiting. Abdominal distension

Department of  
Radiology,  
Great Ormond Street  
Hospital for Children,  
London  
C M Hall  
D G Shaw

Department of  
Radiology, St George's  
Hospital, London  
C S Ng

Correspondence to: Dr C M Hall, Department of Radiology, Great Ormond Street Hospital for Children NHS Trust, London WC1N 3JH.



*Figure 1 Case 1: lateral contrast swallow showing a retropharyngeal soft tissue swelling, loss of the normal cervical lordosis, and a posterior leak of contrast (arrow). Nasogastric tube present.*

was noted an hour after admission, and there were bruises over the right cheek, forehead, and lumbar region.

Chest and abdominal radiographs showed free intraperitoneal air, and also rib fractures of different ages (a left 10th rib fracture was associated with callus, and an 11th rib fracture was associated with a periosteal reaction, but no callus) (see fig 3A). Emergency computed tomography confirmed these findings, and also showed small pockets of retroperitoneal air and a contrast enhancement defect in the posterior aspect of the spleen (see fig 3B). The latter being consistent with a splenic haematoma or laceration.

A laparotomy showed free intraperitoneal bile and air, a complete rupture of the third part of the duodenum, and some bleeding from the posterior surface of the spleen, although the splenic capsule was intact. There were also two serosal tears of the ileum and a retroperitoneal haematoma in the right iliac fossa.

Histopathology of the resected duodenum indicated that there had been episodes of trauma separated in time, as in some areas there was evidence of active granulation tissue, haemosiderin filled macrophages, and established mucosal regeneration, suggesting that some of the damage to the bowel was at least two days old. On the other hand, there were also extensive areas of acute mucosal necrosis which indicated more recent trauma, occurring within 24 hours.

Possible causes offered by the parents for the abdominal injuries, which are considered to be completely inadequate, were falling across the edge of a box, and being pushed by her 3 year old sister against bicycle handle bars. The child was placed on the child protection register under the category of 'actual physical abuse'; her older siblings, aged 3, 7, and 11 years, were

placed on the same register under the category of 'likely physical abuse'.

#### PATIENT 4: FATAL TRAUMATIC RUPTURE OF THE DUODENUM

A girl initially presented at the age of 4.6 years with a spiral fracture of the right femur, for which no appropriate history was elicited. Five months later (five days after her 5th birthday), she presented with collapse and a one day history of increasing abdominal pain. An abdominal radiograph revealed a pneumoperitoneum. There were also multiple bruises and small abrasions on her limbs, back, and abdomen. She could not be resuscitated.

At postmortem examination, there were two full thickness tears of the third part of the duodenum, and a partial thickness tear of the proximal jejunum just distal to the duodenojejunal flexure. There were also bruises in the jejunal mesentery and wall of the ascending colon. The injuries were consistent with blunt trauma to the abdomen, but no appropriate accidental cause was elicited.

A skeletal survey conducted at the postmortem examination showed, in addition to the healing spiral fracture of the femur from the above previous injury, a recent (10 days to six weeks) fracture of the lower shaft of the right radius. Again, no satisfactory explanation for the latter injury could be obtained.

#### PATIENT 5: MESENTERIC TEAR AND SUBACUTE INTESTINAL OBSTRUCTION SECONDARY TO MULTIPLE SMALL BOWEL STRICTURES

A boy presented at the age of 4 months with abdominal distension, bilious vomiting, and a right inguinal swelling. An abdominal radiograph showed dilated loops of bowel consistent with a partial obstruction. An uneventful right hernia repair was carried out. During the operation, some blood was noticed around the tunica vaginalis.

The child presented again three weeks later with recurrent symptoms. On this occasion, an abdominal radiograph showed, in addition to the previous findings, callus around rib fractures and the proximal right femur. A barium follow through study showed a low small bowel obstruction.

A laparotomy showed multiple small bowel strictures, inflammatory adhesions, and a mesenteric tear 15 cm proximal to a Meckel's diverticulum. Several features pointed to a traumatic, rather than a congenital, aetiology. The mesenteric defect itself was just adjacent to the bowel wall and had ragged (rather than smooth) edges; this occurs in relation to traumatic injuries, but not in congenital lesions. The blood supply to the bowel in congenital mesenteric lesions is intact; in traumatic lesions, the intestine is often partially devascularised, leading to fibrosis and stricturing of the bowel, as in this case.

Blunt abdominal trauma, for example, a kick or impact with a blunt instrument, was considered to be the most likely cause of these of injuries. The blood in the tunica vaginalis, noted at the initial operation, was probably due

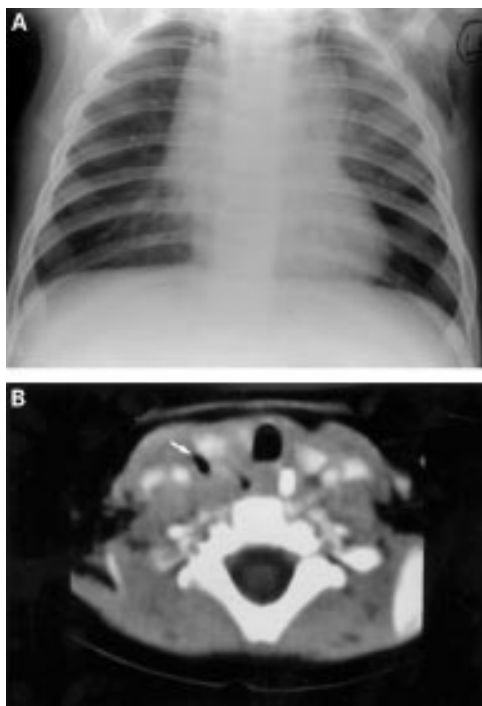


Figure 2 Case 2: (A) chest radiograph showing air in the mediastinum and left axilla, and (B) intravenously enhanced computed tomogram of neck, showing air in the right parapharyngeal space (arrow).

to the tracking of intraperitoneal blood down the patent processus vaginalis into the scrotum.

The child had in fact already been placed on the 'at-risk' register at the age of 3 weeks, because 'bucket handle' and metaphyseal fractures involving several limbs had been identified. Multiple fractures were demonstrated on subsequent occasions which included fractures involving the pelvis (a rare occurrence in NAI).<sup>14</sup> An inquest was conducted at another hospital after his death at the age of 5 months from respiratory difficulties.

#### PATIENT 6: FATAL TRAUMATIC RUPTURE OF THE LIVER AND SPLEEN SECONDARY TO BLUNT ABDOMINAL TRAUMA

A boy, one day after his first birthday, had apparently 'collapsed' at home. Cardiopulmonary resuscitation by ambulance and casualty staff was unsuccessful.

Bruises above the umbilicus and left eye brow were evident. A postmortem examination revealed 40 ml of intraperitoneal blood, a fresh rupture of the inferior edge of the liver, ruptures of the lesser omentum, transverse mesocolon, and jejunal mesentery, complete rupture and separation of the pancreas. The injuries were consistent with a (minimum of one) forceful blow to the upper part of the abdomen.

Radiographs taken at the postmortem examination showed multiple rib fractures, all with no evidence of periosteal reactions, which would date the fractures at less than seven days. Further rib fractures were also revealed at the postmortem examination. Such rib fractures are only likely to be caused by extremely severe compressive or squeezing force, or an extreme blow; cardiopulmonary resuscitation does not

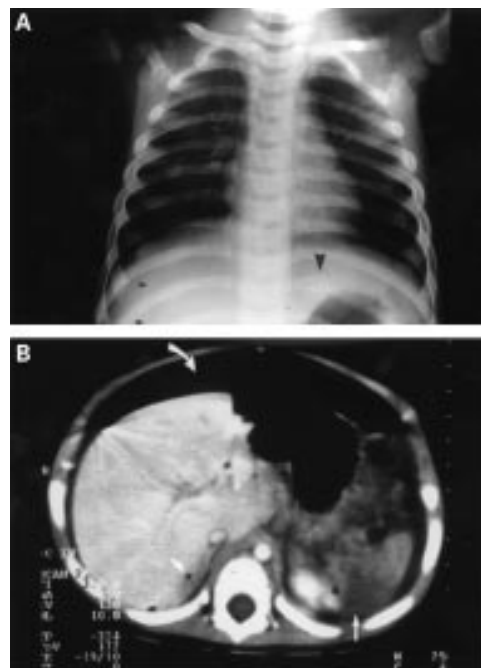


Figure 3 Case 3: (A) supine chest radiograph showing free intraperitoneal air (small arrowheads) and a fracture with callus formation of the posterior aspect of the left 10th rib (large arrowhead), and (B) intravenously enhanced computed tomogram showing free intraperitoneal air (curved arrow), retroperitoneal air (short arrow), and a perfusion defect of the posterior aspect of the spleen (long arrow).

generate sufficient forces to fracture ribs.<sup>15</sup> A satisfactory history to account for these findings could not be obtained.

#### PATIENT 7: PANCREATIC RUPTURE AND PORTAL VEIN TEAR

A boy aged 1.5 years was brought to a casualty department by both his parents because of vomiting, having allegedly fallen down some stairs one hour earlier.

He had bruises of different ages around his face and head, bruises on his back and abdomen consistent with being gripped, and marks on his buttocks consistent with being slapped. He also had multiple bite marks over his left ear, arms, and lumbar spine, allegedly caused by other children. The bite involving his left arm, however, was considered to have been caused by an adult's mouth.

Examination also revealed a tender and distended abdomen with absent bowel sounds. An emergency laparotomy showed free blood within the peritoneum, a haematoma of the transverse mesocolon, a tear in the portal vein, and almost complete transection of the head of the pancreas. The tear in the portal vein was sutured, and an attempt at repairing the pancreatic transection was made. The abdominal injuries were considered to be due to blunt abdominal trauma.

Computed tomography was performed four days after admission because of recurrent abdominal distension and a general deterioration. This showed a swollen pancreas and the transection of the head/neck of the pancreas. In addition, there was now a large pseudocyst lying anterior to the pancreas, and multiple



Figure 4 Case 7: contrast enhanced computed tomogram of the abdomen, showing transection of the head/neck of the pancreas (long arrow), a large pseudocyst (curved arrows), and multiple peripheral enhancement defects in the spleen (short arrows).

peripheral enhancement defects in the spleen consistent with infarcts (fig 4). These findings were confirmed at a further laparotomy.

A skeletal survey showed acute fractures of the anterior aspects of the right and left sixth and seventh ribs, and a healing fracture of the distal metaphysis of the right radius. There had also been a previous history of a near drowning episode when aged 12 months. A child protection order was granted.

#### PATIENT 8: SUBCAPSULAR HAEMATOMA OF THE LIVER

A 2 year old girl was admitted with a one day history of fever, wheeze, and cough. She also had abdominal pain and vomiting, with generalised tenderness and tenseness of the abdomen. A chest radiograph showed a right middle lobe pneumonia for which antibiotic treatment was given. Three days after admission, a tender and diffuse  $5 \times 5$  cm right upper quadrant abdominal swelling, together with oedema of the abdominal wall was noted.

Ultrasound confirmed extensive oedema of the anterior abdominal wall, and revealed a  $6 \times 2$  cm hypoechoic lesion in the subcapsular region of the anterior surface of the right lobe of the liver, consistent with a haematoma or a liver abscess (possible aetiologies for the latter being trauma, neoplasms, or infection). A subsequent ultrasound evaluation five days later showed a reduction in the size of the abnormality, and a follow up scan four weeks later showed complete resolution of the lesion. The rapid and complete resolution of the liver lesion suggested that it had been a haematoma, rather than a liver abscess.

Two weeks before the above events, her 1 year old brother had been referred by their general practitioner and was found to have a left parietal skull fracture, a burn on the dorsum of his right foot, and finger mark bruises on the back of his neck. The injuries were of different ages, and no satisfactory explanation for the injuries was offered. Both children were placed on the child abuse register.



Figure 5 Case 10: supine abdominal radiography showing free intraperitoneal gas demonstrated by gas outlining the falciform ligament (long arrow) and gas on both sides of the bowel wall (Rigler's sign, short arrows). There are also fractures of both superior pubic rami.

#### PATIENT 9: INTRAPERITONEAL RUPTURE OF THE BLADDER

A 5 year old girl presented with abdominal pain. She had generalised abdominal tenderness, worse in the right iliac fossa, and abdominal rigidity. There were bruises on her forehead and right ear. She was unwilling to give a history.

A plain abdominal radiograph showed some dilated gas filled loops of small bowel representing an ileus. A clinical diagnosis of appendicitis with peritonitis was made. A laparotomy however revealed a 5 cm tear in the dome of the bladder, together with a litre of blood tinged intraperitoneal fluid and distended loops of proximal small bowel.

As a result of these findings a place of safety order was made. This was supported by a previous fracture of the left mandible when aged 3 years old, and which was considered to be non-accidental at the time because of the varied and inconsistent history given by the parents.

#### PATIENT 10: RECTAL PERFORATION

A girl aged 2.4 years presented with vomiting. She had apparently fallen down about 12 steps on the day before admission, but had then been able to carry on playing. The maximum tenderness and rigidity appeared to be in the lower half of the abdomen. There were numerous lacerations and bruises of different ages involving her face, chest, and back, and old deep burns on the tops of both feet. Chest and abdominal films showed intraperitoneal free gas and healing fractures of both superior pubic rami (see fig 5).

A laparotomy revealed a 1cm laceration of the anterior wall of the rectum, just above the

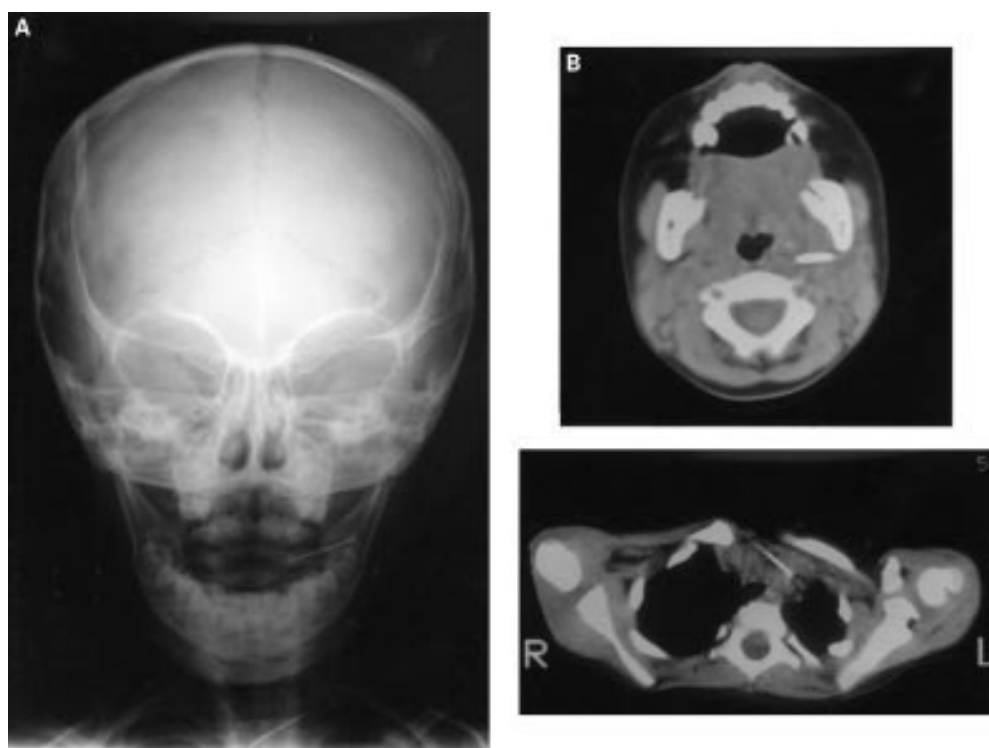


Figure 6 Case 11: (A) radiograph showing needles projected over the left temporal region, left side of the neck, and upper mediastinum, and (B) intravenously enhanced computed tomogram of neck and upper mediastinum, showing the close proximity of the needles to the left carotid sheath, and the great vessels of the aortic arch.

pelvic floor, and a fibrinous and purulent exudate throughout the peritoneal cavity. Superficial anal fissures and a somewhat patulous anus were noted. These findings were considered to relate to sexual abuse.

A skeletal survey also showed a fracture separation of the proximal right humerus and a metaphyseal fracture of the distal left radius. There were also angulation deformities of the left mandible, a fibula, and a metacarpal bone, consistent with old healed or healing injuries. These skeletal injuries indicated the presence of concomitant physical abuse. The child was placed on the at-risk register.

#### PATIENT 11: PENETRATING NEEDLE TRAUMA

A girl aged 1.5 years of Indian parents, was admitted for investigation because a postmortem examination on her 26 day old younger sister had revealed multiple needles within the sister's body and brain. The index child had previously been on the at-risk register, but had been removed from the list because of insufficient evidence.

She was asymptomatic, but had multiple pin prick scars on her limbs and upper torso. A skeletal survey showed needles in the neck, mediastinum, and left temporal region (see fig 6A), and left forearm. Computed tomography of the neck and chest showed that the needles were very close to vital structures: the left carotid sheath and the great vessels of the mediastinum (see fig 6B).

The foreign bodies were surgically removed. The child was placed on the child protection register, and was subsequently placed into care.

#### PATIENT 12: PENETRATING NEEDLE TRAUMA TO THE ABDOMEN

A 8 week old boy was transferred when an abdominal radiograph had revealed multiple foreign bodies within the abdomen. He had been born prematurely at 25 weeks' gestation, the product of a concealed pregnancy. His mother was of African origin and was visiting London. The perinatal period was complicated by hyaline membrane disease and sepsis.

An abdominal radiograph taken at 6 weeks had shown two metallic needles projected over the lower abdomen (see fig 7A). There were no signs of external injury. No needles were found in the cot, but nevertheless the needles were thought to be artefacts lying outside the baby. A subsequent film taken 10 days later when the child had become unwell, showed the same two needles and two further needles projected over the upper abdomen (see fig 7B).

At laparotomy, three of the needles were associated with abscess formation. Of the two needles in the pelvis, one was wholly within the rectal wall, and one had its blunt end in the posterior rectal wall, suggesting that these had been inserted per rectum, and would explain why no external injuries were seen after the initial radiograph. The other two needles were thought to have been inserted percutaneously through the umbilical region and the back where there were supporting marks on the skin.

The child was placed on the child protection register, and subsequently into care.

Table 1 presents a summary of the cases and their visceral, skeletal, and superficial injuries.

Table 1 Summary of patients and injuries

Patient No	Age/sex	Type of injury		
		Visceral	Skeletal	Superficial
1	7 weeks/girl	Pharyngeal	None	Torn frenulum
2	4 months/boy	Pharyngeal	Humerus spiral fracture ulna, humeral, parietal skull fractures (subsequently)	None
3	7 months/girl	Duodenal rupture and splenic injury	Multiple rib fractures	Face and lumbar bruises
4	5.0 years/girl	Duodenal rupture	Femur spiral fracture and distal radial fracture	Limb, back, and abdominal bruises
5	4 months/boy	Mesenteric tear	Multiple metaphyseal and shaft fractures of upper and lower limbs; multiple rib fractures and pubic ramus	Bruises on limbs and sores on skin
6	1.0 years/boy	Liver, spleen, pancreatic, and mesenteric ruptures	Multiple rib fractures	Facial, trunk, and limb bruises
7	1.5 years/boy	Pancreatic rupture and portal vein tear	Healing metaphyseal fracture of distal radius and acute rib fractures	Bruises on face, head, back, buttocks and bite marks on ear, back, and arms
8	2.0 years/girl	Liver haematoma	None	Abdominal wall swelling
9	5.0 years/girl	Bladder rupture	Mandible fracture	Facial and ear bruises
10	2.4 years/girl	Rectal perforation	Metaphyseal fractures of radius and humerus; superior pubic rami, old mandibular, fibular, and metacarpal fractures	Facial, chest, back bruises and burns on feet
11	1.5 years/girl	Penetrating needles	None	Pin prick scars on limbs and upper torso
12	8 weeks/boy	Penetrating needles	None	Skin puncture marks

### Discussion

The incidence of NAI and neglect has been steadily increasing. In the USA, in 1974 there were 60 000 reported cases of suspected NAI. This rose in 1992 to 2 900 000, an incidence of approximately 2.5% in children under 17 years of age.<sup>1</sup> In England and Wales, the National Society of Prevention of Cruelty to Children has found an increase in the registration rate of cases from 0.63 per thousand (under 17 years of age) in 1983, to 0.83 per thousand in 1987. In the city of Leeds, a steady increase in cases of NAI has been recorded between 1969 and 1987.<sup>16</sup> Contributory factors in this rise in incidence may be an increased awareness by the public and by healthcare professionals, and also an increased breakdown in family stability. Boys just outnumber girls by approximately

55:45. The fatality rate among cases of NAI in England and Wales is approximately 0.6%.<sup>16</sup>

Injuries to internal visceral organs form a relatively small proportion of reported cases of NAI; precise data is not available, but it is estimated to be in the region of 2% to 3% of reported cases of NAI.<sup>9, 12</sup>

Table 1 shows 12 patients (age range 7 weeks to 5 years) of NAI involving visceral injuries to the pharynx, abdomen, and pelvis. These patients have been drawn from 300 patients referred or admitted to two centres. There is undoubtedly a degree of selection bias, as our two centres are somewhat specialised, nevertheless, our observed incidence of such injuries, 12/300 (4%), concurs with the estimates of Kirks.<sup>9</sup> Our small series of visceral injuries shows a slight female predominance

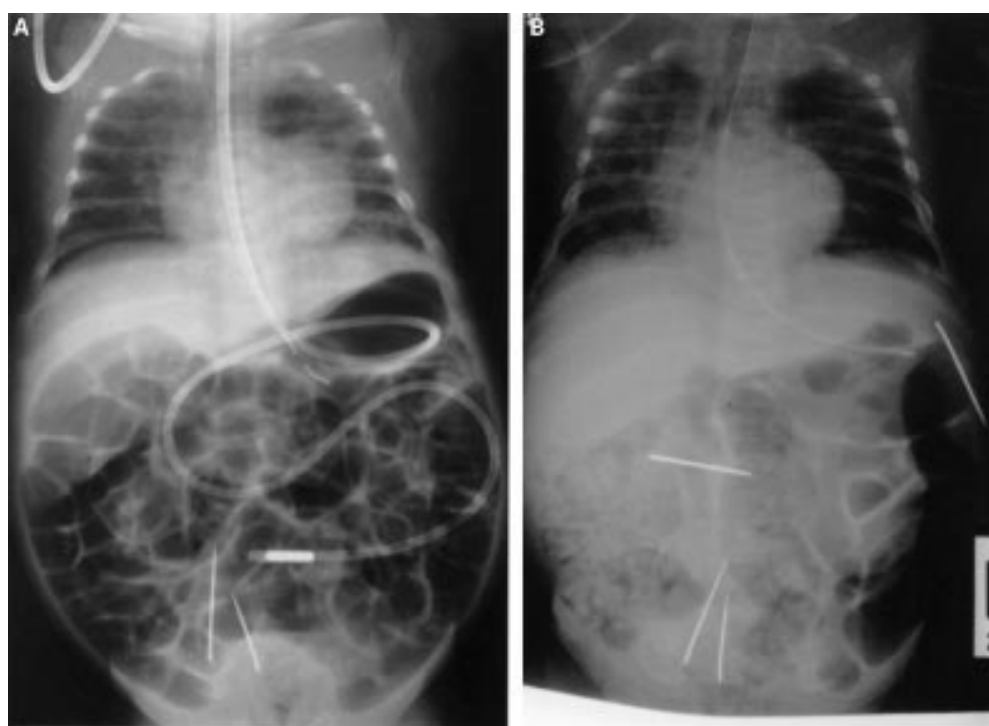


Figure 7 Case 12: (A) abdominal radiography at 6 weeks of age, and (B) abdominal radiography taken two weeks later.

(seven girls, five boys) in contrast with the slight male predominance reported above.

Injuries involving the duodenum are probably the most common intra-abdominal injury in blunt trauma to the abdomen, and include duodenal haematomas or transection (as in our patients 3 and 4). Such injuries to the duodenum occur because the ligament of Treitz is a relatively fixed structure and allows compression of the duodenum against the vertebrae.<sup>9</sup> It is not infrequently associated with injuries to the adjacent organs. Unfortunately, there may be delays in making the diagnosis because the retroperitoneum (in which part of the duodenum lies) offers some protection, and this may contribute to the morbidity and mortality of these injuries.<sup>17</sup>

Life threatening intra-abdominal injuries can exist with few symptoms or signs. Fossum and Descheneaux described a 2.5 year old child who presented with relatively few symptoms, who at postmortem examination was found to have peritonitis secondary to a duodenal rupture which was considered to have occurred two or three days before death.<sup>18</sup> In this case, the postmortem examination also showed extensive mesenteric scarring, considered to have been secondary to blunt trauma some months earlier. These findings of blunt trauma are similar to those in our patient 5. Evidence of abdominal trauma, prior to the acute episode, was also shown in our patient 3.

Liver injuries can also be occult with no evidence of external injuries. Our patient 8 probably only came to light because of her coincidental pneumonia. Coant *et al* found, in children suspected of NAI who had no history or physical signs of abdominal trauma, evidence of occult liver lacerations on computed tomography in 6% of cases.<sup>19</sup> They found also that raised transaminases were associated with these cases and consider that this is a useful indicator of occult liver injury.

NAI as a cause of pancreatic injury is not uncommon (see our patients 6 and 7); Ziegler *et al* reported one third of their series of 49 cases of pancreatitis in children as being associated with NAI.<sup>20</sup> As in adults, pancreatitis in children is associated with considerable morbidity and chronic pancreatitis may develop.<sup>21</sup>

Pharyngeal injuries in NAI are rare. In a review of 511 cases of NAI, Fonseca *et al* reported a 75% incidence of injuries to the head, face, mouth, and neck; when also including cases of sexual abuse and neglect, the authors found that the face, head, neck, and mouth were involved in 17%, 9%, 3%, and 2% of cases respectively.<sup>22</sup> Injuries included intraoral lacerations, and bony and dental fractures. In a review of 85 patients with a diagnosis of abuse or neglect, Leavitt *et al* reported 56% with abnormalities to the head and neck region.<sup>23</sup> In this group, facial injuries were again the most common (56%), with oral and pharyngeal injuries being comparatively uncommon, accounting for only 16%. Potential complications of pharyngeal and oesophageal trauma include pharyngeal and mediastinal abscesses and pseudocysts, and airway

obstruction.<sup>24</sup> It is noteworthy that our two cases with this type of injury (patients 1 and 2) were infants, and were younger than 4 months of age.

The stigmata of sexual abuse are well described and illustrated.<sup>3, 25</sup> Sexual abuse leading to visceral rupture (see our patient 10), however, is most unusual. Bladder rupture in NAI, as in our case 9, is equally rare with very few reported cases.<sup>26, 27</sup>

Our two subjects with penetrating needle injuries (patients 11 and 12) are most unusual. Such perforating injuries are much less common than blunt injuries.<sup>12</sup> Swadia and colleagues<sup>28</sup> and Hadley *et al*<sup>29</sup> have reported similar needles injuries in an 11 year old Indian boy and in six Zulu children, respectively, and we speculate that the ethnic and cultural origins of both our patients (African and Indian) may be relevant.

Head injuries are not uncommon in NAI and are the leading cause of fatal child abuse.<sup>6</sup> Eighty per cent or more of deaths from head trauma in patients less than 2 years of age occur because of NAI. Mechanisms of injuries to the head include severe direct trauma and shaking, which may result in skull fractures, subdural haematomas, intracerebral shear injuries, and retinal haemorrhage.<sup>4, 5</sup> One of our subjects (patient 2) had a skull fracture, and one had a near penetrating needle injury (patient 11).

Of the 12 cases presented above, seven had skeletal injuries from before the visceral injuries, suggesting that visceral manifestations indicate an escalation in the general level of violence and trauma. Indeed, three of the cases led to a fatal outcome. This relatively high morbidity and mortality in visceral injuries has been previously observed: injuries to the abdomen are the second leading cause of fatal child abuse, and the mortality from abdominal injuries from NAI has been estimated at 40% to 50%.<sup>6, 30</sup> Factors contributing to the relatively high morbidity and mortality include (a) the shear force of trauma, (b) delays in recognising the presence of visceral injuries because of the frequent lack of symptoms and physical signs and, (c) delays in recognising the underlying non-accidental aetiology.

Careful scrutiny of radiographs may show associated fractures, as illustrated in some of our cases. This may provide vital clues in revealing the underlying aetiology. Communication between hospitals, general practitioners, and other caring professionals needs to be excellent as patients sometimes present to different agencies, as in our patient 5. Likewise, in our patient 2, the initial pharyngeal and radiographic findings were highly suspicious of NAI in their own right. It was, however, only when alerted about subsequent skeletal injuries (via social services from another hospital) that sufficient substantiating evidence could be obtained.

Seven of our 12 patients were over 1 year of age, which is somewhat older than the typical age in which skeletal and head manifestations of NAI occur. The mechanism for this finding may be that older children who can walk are

able to escape being grabbed and shaken, but nevertheless are vulnerable to blows.

NAI is not often considered in the differential diagnosis of acute abdominal or of acute respiratory symptoms; these cases hopefully show that it should be. There should be a high index of suspicion, particularly if the injuries are unusual in any way. Radiology plays an important part in evaluating the presence and extent of the visceral and associated injuries, and careful scrutiny of radiographs may give vital clues to the underlying non-accidental aetiology of the trauma.

We would like to thank Dr Victor Larcher for his assistance with one of the cases.

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